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10/707,259

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Hsiu-Chun Lee

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NORTH AMERICA INTELLECTUAL PROPERTY CORPORATION
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EXAMINER

CHACKO DAVIS, DABORAH

ART UNIT

PAPER NUMBER

1756

| SHORTENED STATUTORY PERIOD OF RESPONSE | NOTIFICATION DATE | DELIVERY MODE |
|--|-------------------|---------------|
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3 MONTHS

03/22/2007

ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Notice of this Office communication was sent electronically on the above-indicated "Notification Date" and has a shortened statutory period for reply of 3 MONTHS from 03/22/2007.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Patent.admin.uspto.Rcv@naipo.com
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| | | | |
|------------------------------|----------------------------------|----------------------------|--|
| Office Action Summary | Application No. 10/707,259 | Applicant(s) LEE ET AL. | |
| | Examiner Daborah Chacko-Davis | Art Unit 1756 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 December 2006.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-7 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 1-7, are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

3. Claims 1-7, are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential elements, such omission amounting to a gap between the elements. See MPEP § 2172.01. Claims 1-7, recite "a method for forming a semiconductor feature with controlled critical dimension". The body of the claims merely recites a hard mask patterning method. There is no suggestion in the claims in regards to CD (critical dimension) measurements, or thickness determinations etc., or any insitu profilometric data employed in the processes performed, or how the CD of the pattern is controlled. Appropriate correction is required.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-4, are rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent No. 6,346,366 (Chu et al., hereinafter referred to as Chu) in view of U. S. Patent Application Publication No. 2004/0224524 (Koenig et al., hereinafter referred to

Art Unit: 1756

as Koenig) and U. S. Patent No. 6,533,907 (Demaray et al., hereinafter referred to as Demaray).

Chu, in the abstract, in col 1, lines 7-20, in col 2, lines 58-67, in col 3, lines 1-15, in col 4, lines 61-67, in col 5, lines 1-18, discloses a method patterning a semiconductor substrate (forming features for integrated circuit fabrication) comprising coating a substrate with a polysilicon layer (semiconducting layer), followed by a silicide layer (semiconducting layer); forming a silicon nitride layer (cap layer) on the silicide layer; forming a photoresist pattern on the silicon nitride layer (cap layer); performing an anisotropic dry etching, using the photoresist pattern as the etch hard mask, to etch anisotropically (therefore maintaining the CD of the photoresist pattern) the exposed portions of the silicon nitride layer (semiconductor layer) so as to transfer the photoresist pattern (dimensions of the pattern transferred to the underlying layers) to the silicon nitride layer; performing an anisotropic dry etching, using the patterned silicon nitride hard mask as the etch mask, to transfer the pattern (features) to the semiconductor layer (claims 1-4).

The difference between the claims and Chu is that Chu does not disclose sputtering silicon on the top surface and the vertical sidewalls of the photoresist pattern, and using the silicon thin film and the photoresist pattern as the etching hard mask. Chu does not disclose that the thickness of the silicon film on the sidewall (vertical sidewall thickness "x") is not equal to the thickness of the silicon film on the top surface ("y") of the pattern ($x \neq$ or $< y$). Chu does not disclose that the $x < 5\text{nm}$ (claim 6). Chu does not disclose that $x < 1\text{nm}$ (claim 7).

Koenig, in [0020], [0021], and [0023], discloses forming a silicon layer on the sidewalls and top surface of the resist pattern (coating covering the resist feature conformally), and using the silicon coated resist pattern as the mask to perform further etching. Koenig, in [0020], discloses that the sidewall of the feature has a thickness and that the resist feature is also covered substantially i.e., the vertical sidewall thickness is not equal to the top surface coating thickness. Koenig, in [0021], discloses that the vertical sidewall thickness is about 3nm (about 3nm includes 1nm).

The difference between the claims and Chu in view of Koenig is that Chu in view of Koenig does not disclose that the silicon deposited on the top surface and sidewalls of the resist pattern is deposited by sputtering.

Demaray, in col 8, lines 45-62, discloses that the silicon is sputter-deposited to form the silicon hard mask.

Therefore, it would be obvious to a skilled artisan to modify Chu by employing the suggestion of Koenig to conformally coat the resist feature (pattern) with the silicon layer because Koenig, in [0020], discloses that the silicon coating covering the resist feature enables the preservation of the lateral dimensions of the mask during the etch processes, and Koenig in [0023], discloses that the silicon coating on the resist feature inhibits the etching of the resist feature sidewall during etch processes. It would be obvious to modify Chu in view of Koenig by employing the method of sputter coating the silicon layer as suggested by Demaray because Demaray, in col 8, lines 45-64, discloses that the sputter coated silicon hard mask has a smoother surface and is well-

Art Unit: 1756

suited for use as hard mask for etching features with required sidewall smoothness for use in IC devices.

Response to Arguments

6. Applicant's arguments filed December 21, 2006, have been fully considered but they are not persuasive. The 103 rejection made in the previous office action (paper no. 20060915) is maintained.

A) Applicants argue that none of the reference teach "selectively sputtering a silicon thin film merely on the top surface and the vertical sidewalls of the photoresist pattern but not substantially on the cap layer in the claimed $x \neq y$ thickness".

Chu is not depended upon to disclose the deposition of the silicon film on the top surface and sidewall of the resist pattern as recited. Koenig is depended upon to disclose the deposition of the sacrificial coating of silicon on the resist feature and the resist pattern sidewall wherein the sacrificial coating only coats the features of the resist layer on the features so as to enable etching of the portions not covered by the features. Therefore Koenig does teach selectively coating silicon film on the resist features i.e., sidewall and top surface of the resist pattern (see paragraph nos. [0020], [0021], [0022]). Demaray is depended upon to disclose the method of depositing silicon using the sputter deposition technique.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

Art Unit: 1756

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daborah Chacko-Davis whose telephone number is (571) 272-1380. The examiner can normally be reached on M-F 9:30 - 6:00. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark F Huff can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you

Application/Control Number: 10/707,259

Page 7

Art Unit: 1756

have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

dcd

MD

March 14, 2007

Mark L. Velt

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TECHNOLOGY CENTER 1700